

*PROCAMBARUS (ORTMANNICUS) LEITHEUSERI*, NEW  
SPECIES, ANOTHER TROGLOBITIC CRAYFISH  
(DECAPODA: CAMBARIDAE) FROM  
PENINSULAR FLORIDA

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*Abstract.*—A new troglobitic crayfish, *Procambarus (Ortmannicus) leitheuseri*, is described from six localities in Hernando and Pasco counties, Florida. Its closest affinities seem to be with the two subspecies of *P. (O.) lucifugus*. It may be distinguished from the nominate subspecies by the presence of pigment in the eye, and from *P. (O.) l. alachua* by features of the first pleopod of the male, among which is the absence of a caudal process.

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Twelve troglobitic crayfishes belonging to three genera are now known to inhabit the subterranean waters of Florida. Except for *Procambarus (Ortmannicus) franzi* Hobbs and Lee (1976) and the new species described herein, all were included in a review of the American troglobitic decapods (Hobbs et al., 1977). These two crayfishes not reported there occur in the peninsular section of the state: *P. (O.) franzi*, known only from the type-locality, Orange Lake Cave (Sec. 33/34, T. 12S, R. 21E) and Hell Hole (Sec. 6, T. 14S, R. 21E), Marion County, and *P. (O.) leitheuseri*, new species, from six localities in Hernando and Pasco counties. The latter records mark the southwestern limits of the known range of the troglobitic members of the subgenus *Ortmannicus* in peninsular Florida. A key to the albinistic crayfishes of the subgenus is appended to the description that follows.

We are pleased to name this crayfish for its discoverer Arthur T. Leitheuser, who has added much to our knowledge of the distribution of the troglobitic crayfishes of Florida.

*Procambarus (Ortmannicus) leitheuseri*, new species

Fig. 1

*Diagnosis.*—Albinistic, eyes without facets but provided with small pigment spot. Rostrum with marginal spines; median carina absent. Carapace with cervical spine cephaloventral to row of small spines or tubercles flanking caudal margin of cervical groove. Aerola 6.3 to 10.4 times as long as broad and constituting 32.9 to 38.2% of total length of carapace (43.8 to 49.7% of postorbital carapace length). Suborbital angle absent. Postorbital ridge with cephalic spine and with or without 2 to several more posterior spines or tubercles. Hepatic area with many small tubercles, some spiniform. Antennal scale about twice as long as wide, broadest slightly distal to midlength. Ischia of third and fourth pereopods of first form male with simple hooks, that on third overreaching basioischial articulation and that on fourth highly arched, almost reaching basioischial articulation but lacking opposing tubercle on basis; coxa of fourth pereopod with prominent oblique boss. First pleopod of first form male reaching coxa of third pereopod, asymmetrical, provided with subapical setae; distal extremity bearing subspiculiform mesial

process directed caudally at approximately 75 degree angle to shaft of appendage and curved somewhat laterally; cephalic process acute, somewhat hooding central projection cephalically, and directed caudodistally; caudal element lacking caudal knob but represented by prominent, corneous adventitious process caudomesially, latter rounded distally, convex mesially, and somewhat concave laterally; and corneous beaklike central projection, most conspicuous of terminal elements, directed caudodistally subparallel to cephalic process. Annulus ventralis freely movable, subrhomboidal, about twice as broad as long, and completely exposed, not partly hidden by projections from sternum immediately cephalic to it; cephalic area with convex, elevated marginal area bearing submedian, oblique furrow; sinus originating in furrow and following sigmoid curve, terminating almost on median line slightly posterior to midlength of annulus. Postannular sclerite slightly more than half as wide and about half as long as annulus with cephalomedian area somewhat inflated. First pleopod in female moderately well developed.

*Holotypic male, form I.*—Cephalothorax (Fig. 1a, k) subcylindrical. Abdomen narrower than thorax (8.4 and 10.0 mm). Greatest width of carapace greater than height at caudodorsal margin of cervical groove. Areola 8.4 times as long as wide with 1 or 2 punctations across narrowest part. Cephalic section of carapace approximately 1.6 times as long as areola, length of latter 38.2% of entire length of carapace (48.0% of postorbital carapace length). Rostrum with margins subparallel along caudal half and gently convergent to base of acumen where provided with small slightly divergent marginal spines. Acumen reaching base of distal fourth of ultimate segment of antennular peduncle; dorsal surface excavate and punctate. Subrostral ridge weak and evident in dorsal aspect along caudal seventh of rostrum. Postorbital ridges well developed, grooved dorsolaterally, and terminating cephalically in small corneous spine; posteriormost part of right ridge with 3 minute corneous subacute tubercles, left with 5, two of which somewhat lateral to axis of ridge. Dorsolateral part of cervical groove flanked caudally by row of spiniform tubercles, ventralmost member of row (cervical spine) larger than others. Suborbital angle obsolete. Branchiostegal spine moderately strong and acute. Except for anterior parts of orbital, antennal, and mandibular areas, entire dorsolateral and lateral surfaces of carapace studded with tubercles, some of which spiniform.

Abdomen slightly longer than carapace (23.5 and 22.0 mm). Pleura of third through fifth abdominal segments rounded anteroventrally and angular caudoventrally. Cephalic section of telson with 2 spines in each caudolateral corner, more mesial one in each movable. Cephalic lobe of epistome (Fig. 1j) cordiform, with cephalolateral margins slightly elevated (ventrally); main body with anteriorly flared depression but lacking distinct fovea; epistomal zygoma broadly arched. Ventral surface of proximal podomere of antennular peduncle with spine slightly distal to midlength. Antenna with prominent spine on lateral surface of basis and another on ventral surface of ischium; flagellum extending caudally beyond telson by almost 4 times length of latter. Antennal scale (Fig. 1i) about twice as long as broad, widest slightly distal to midlength, and lamellar area about 3 times as wide as thickened lateral part.

Third maxilliped overreaching rostrum by length of ultimate podomere; ischium with distolateral margin subserrate, ending in acute prominence, and lateral half

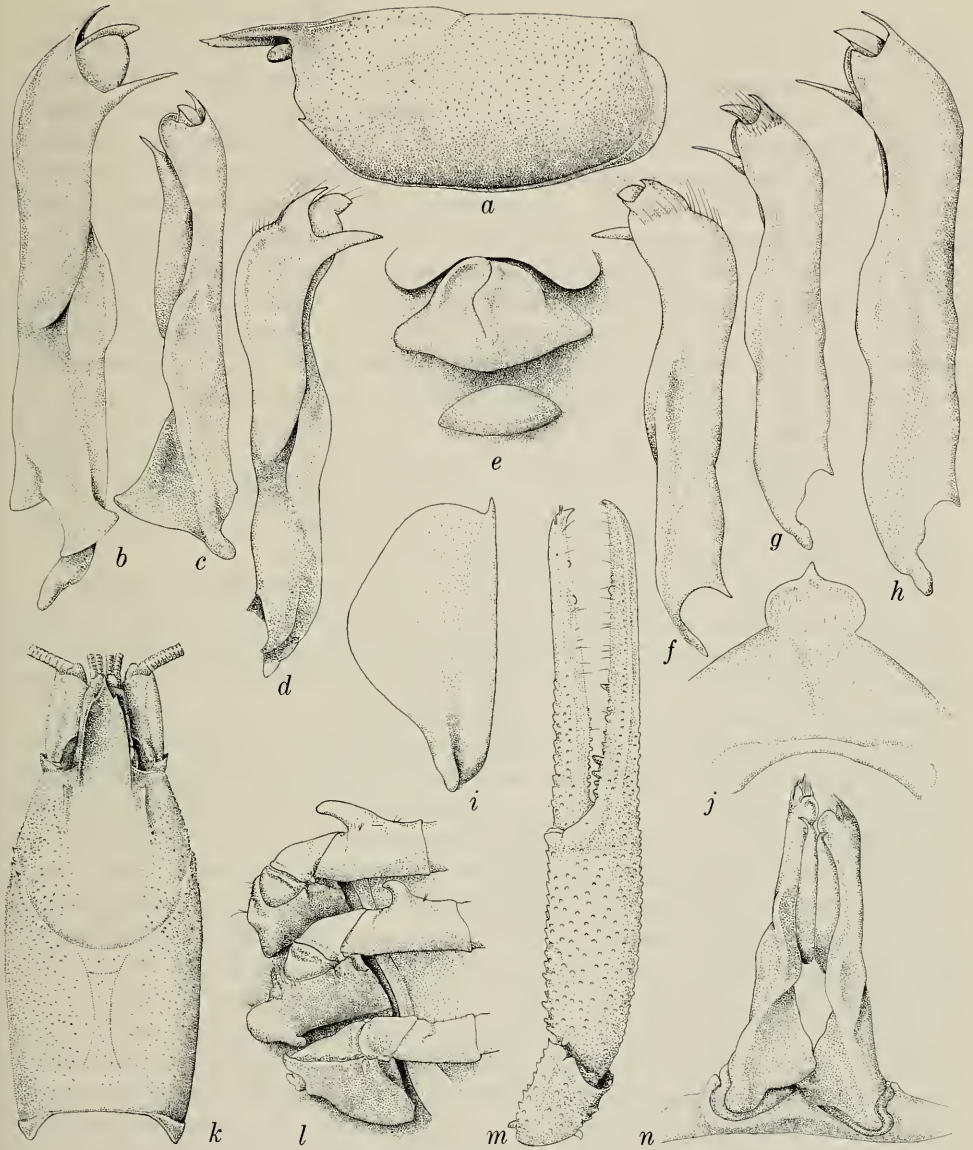


Fig. 1. *Procambarus (O.) leitheuseri* (all illustrations from holotype except *d, f*, from morphotype, and *e* from allotype); *a*, Lateral view of carapace; *b, d*, Mesial view of first pleopod; *c*, Caudolateral view of first pleopod; *e*, Annulus ventralis; *f-h*, Lateral view of first pleopod; *i*, Antennal scale; *j*, Epistome; *k*, Dorsal view of carapace; *l*, Proximal podomeres of third, fourth, and fifth pereopods; *m*, Dorsal view of distal podomeres of cheliped; *n*, Caudal view of first pleopods.

of ventral surface with scattered short setiferous punctations; exopod reaching almost to end of merus.

Right chela (Fig. 1*m*) subovate in cross section, not strongly depressed. Mesial surface of palm with several irregular rows of 12 to 14 strongly elevated tubercles;



remainder of palm strongly tuberculate. Both fingers with well defined submedian longitudinal ridge flanked proximally by tubercles and more distally by setiferous punctations. Opposable margin of fixed finger with row of 9 tubercles along proximal half of finger, fourth from base largest, and with single, large, more ventrally situated one slightly proximal to midlength; row of minute denticles extending between and ventral to row of tubercles from base of finger almost to corneous tip. Lateral surface of fixed finger with tubercles, decreasing in size distally, along proximal half followed by row of setiferous punctations, latter reaching corneous tip of finger. Opposable margin of dactyl with row of 11 corneous tubercles, sixth from base largest, along proximal two-fifths of finger; minute denticles between tubercles and forming broad band immediately distal to last tubercle of row, band continuing to base of corneous tip of finger. Mesial surface of dactyl similar to lateral surface of fixed finger; tubercles, diminishing in size distally, reaching almost midlength of finger.

Carpus of cheliped longer than broad, tuberculate on all surfaces although sparsely so ventrally; 3 most prominent tubercles spiniform, one situated on dorsodistal angle and 2 on ventrodistal margin. Shallow oblique sulcus on dorsal surface flanked by small subsquamous tubercles.

Merus of cheliped strongly tuberculate except for proximal parts of mesial and lateral surfaces. Dorsal surface with sublinear series of tubercles; those on ventral surface not limited to usual 2 rows; rows poorly defined but mesial one consisting of about 25, more distal members of lateral row larger and corneous. Ischium with irregular row of 5 tubercles along mesial margin.

Hooks on ischia of third and fourth pereopods (Fig. 11) as described in *Diagnosis*. Coxa of fourth pereopod with prominent oblique (almost vertically disposed), somewhat inflated boss, its ventral border turned mesially; boss on coxa of fifth pereopod much smaller and tuberculiform.

Sternum between third and fourth pereopods rather deep with conspicuous mat of plumose setae extending mesially from ventrolateral margins. First pleopods (Fig. 1*b, c, g, h, n*) as described in *Diagnosis*. Uropods with both lobes of basal podomere bearing spines, that on mesial lobe very strong; distomedian spine on mesial ramus far removed from distal margin of ramus.

*Allotypic female*.—Differing from holotype in following respects: areola 9 times as long as wide; cephalic section of carapace 1.8 times length of areola, latter only 35.2% of entire length of carapace, 45.3% of postorbital carapace length; acumen with accessory spine on dextral side at base of corneous tip, latter slightly overreaching peduncle of antennule; posterior tubercles of postorbital ridges weak and none corneous; posteroventral extremities of third and fourth abdominal segments not distinctly angular; epistome with paired marginal angles flanking anteromedian projection; antennal flagellum slightly shorter than in holotype; serrations on lateral margin of ischium of third maxilliped less well developed than in holotype; opposable margin of fixed finger of chela with row of 15 tubercles along proximal fourth, third from base largest; tubercles on lateral margin of finger very poorly developed; opposable margin of dactyl with row of 8 tubercles, fifth from base largest; irregular mesial and lateral rows of tubercles on ventral surface of merus consisting of about 16 and 18, respectively.

Annulus ventralis (Fig. 1*e*) only moderately deeply located on sternum (see

*Diagnosis*). First pleopod reaching cephalic margin of annulus when abdomen flexed. (See *Measurements*.)

*Morphotypic male, form II*.—Differing from the holotype, except in secondary sexual characters, in only few respects: spines and tubercles almost everywhere decidedly more prominent, but little different in number or distribution; pigment spot in eye larger and pigment more concentrated; acumen overreaching antennular peduncle by about one-third of its length; subrostral ridges evident dorsally along almost basal half of rostrum; 4 well developed spines along posterior part of postorbital ridge, left with 3; hooks on ischia of third and fourth pereopods much less well developed, and bosses on coxae of fourth and fifth pereopods not nearly so prominent.

First pleopods (Fig. 1*d, f*) only slightly asymmetrical and with distinct hump on preapical cephalic surface. Mesial and cephalic processes strong, and central projection less prominent than in first form male; all disposed much as in holotype, but more distinctly caudally; caudal element not clearly defined.

*Type-locality*.—"Eagle's Nest" (= Lost Sink, Eagle Hole), 5.4 km northwest of the junction of U.S. Highway 19 and State Road 50 (NE $\frac{1}{4}$ , NE $\frac{1}{4}$ , SW $\frac{1}{4}$ , Sec. 21, T. 22S, R. 17E), Hernando County, Florida. This is a flooded cave system that opens to the surface in the bottom of a sinkhole pond 76 meters in diameter, in the Chassahowitzka Swamp. The entrance consists of a series of vertical shafts, most of which are either too small to permit access or are blocked by rocks. The largest shaft, 2 by 2 meters in diameter, opens into the top of a very large bell-shaped gallery at a water depth of 21 meters. The room is roughly oval in shape with the long axis oriented in an east-west direction. Tunnels lead out on the east and west sides, and water flow is from east to west, although some divers have reported observing occasional reversals in this pattern. The highest part of the room's floor is at a water depth of 38 meters, but the floor quickly drops away on all sides to depths of as much as 61 meters. The floors of the room and tunnels are composed of coarse sand and, in places, of large blocks of breakdown. Easily disturbed organic silt, sometimes in thick layers, covers the floor under the entrance shafts and in less traveled, deeper sections of the cave. It is present in cracks and crevices in the ceiling of the room. Divers have explored both the upstream and downstream passages to depths in excess of 91 meters and distances in excess of 300 meters.

*Disposition of types*.—The holotype, allotype, and morphotype are deposited in the National Museum of Natural History (Smithsonian Institution), numbers 178361, 178362, and 178585, respectively, as are paratypes consisting of two second form males (maintained alive) and a dry female. The remaining paratypes (see specimens examined) are deposited in the Florida State Museum.

*Size*.—The largest of the available specimens is a female from Die Polder 3 which has a carapace length of 27.4 (postorbital carapace length, 20.8) mm. Corresponding lengths of the largest male (form II, from Arch Sink) are 24.4 and 18.6 mm. The holotype is the only first form male available (see Tab. 1 for measurements).

*Range and specimens examined*.—*Procambarus (O.) leitheuseri* has been collected in only six localities, all in Hernando and Pasco counties, Florida: HERNANDO COUNTY—(1) the type-locality, 1 ♂I, the holotype, A. T. Leitheuser and L. F. Collins, coll.; (2) Die Polder 2, 3.6 km ENE of junction of U.S. Hwy.

Table 1.—Measurements (mm) of *Procambarus (O.) leitheuseri*.

	Holotype	Allotype	Morphotype
Carapace			
Height	8.9	7.3	10.0
Width	10.0	8.0	11.1
Total length	22.0	17.9	24.4
Postorbital length	17.5	13.9	18.6
Areola			
Width	1.0	0.7	1.2
Length	8.4	6.3	8.8
Rostrum			
Width	3.2	2.4	3.2
Length	5.7	4.9	6.6
Right Chela			
Length, palm mesial margin	7.7	4.2	6.1
Palm width	3.7	2.4	3.6
Length, lateral margin	22.1	12.8	17.9
Dactyl length	12.8	7.5	10.8
Abdomen			
Width	8.4	6.7	9.3
Length	23.5	19.1	24.8

19 and State Rte. 50 (Weekiwachee Springs) (NW $\frac{1}{4}$ , NE $\frac{1}{4}$ , NE $\frac{1}{4}$ , Sec. 5, T. 22S, R. 18E), depth about 60 m, near bottom of shaft, 1 ♀, 24 February 1980, A. T. Leitheuser and J. Bentz, coll.; (3) Die Polder 3, 4.2 km E of junction of U.S. Hwy. 19 and State Rte. 50 (Weekiwachee Springs) (NW $\frac{1}{4}$ , SE $\frac{1}{4}$ , NW $\frac{1}{4}$ , Sec. 5, T. 23S, R. 18E), 1 ♀, 5 September 1982, W. K. Fehring, S. Fehring, coll.; 4 ♀, 9 October 1982, WKF, SF and P. Heinerth, coll. PASCO COUNTY—(4) Black Hole, 4.0 km S of Aripeka (SW $\frac{1}{4}$ , NE $\frac{1}{4}$ , Sec. 14, T. 24S, R. 16E), 1 ♀, PH, coll.; (5) Arch Sink, 6.3 km E of U.S. Hwy. 19 at junction of Kelly Rd. and Aubrey Rd., (NW $\frac{1}{4}$ , NE $\frac{1}{4}$ , SW $\frac{1}{4}$ , Sec. 2, T. 24E, R. 17E), 2 ♂ II, 1 j♀, 11 January 1983, ATL, PH, coll.; (6) Nexus Sink in Beacon Woods System, 2.5 km E of junction of U.S. Hwy. 19 and State Rte. 52 (Bayonet Point) (NE $\frac{1}{4}$ , SE $\frac{1}{4}$ , SE $\frac{1}{4}$ , Sec. 3, T. 25S, R. 16E), 1 ♂ II, 1 ♀, 11 January 1983, ATL, PH, coll. Two males, form II, with carapace lengths of about 25 mm, are being maintained alive at the Smithsonian Institution, and two others at the Florida State Museum, anticipating their molt to form I.

In addition, crayfish presumably belonging to this species were observed by A. T. Leitheuser, W. K. Fehring, P. Heinerth and other divers in at least two other sinks: HERNANDO COUNTY—(1) Little Springs (=Double D's Sink, Twin D's), 1.0 km SW of junction of U.S. Hwy. 19 and State Rte. 50 (Weekiwachee Springs) (NE $\frac{1}{4}$ , NW $\frac{1}{4}$ , SW $\frac{1}{4}$ , Sec. 2, T. 23S, R. 17E); (2) Little Salt Spring, 6.0 km NW of Weekiwachee Springs on State Rte. 50 (NW $\frac{1}{4}$ , NE $\frac{1}{4}$ , NE $\frac{1}{4}$ , Sec. 29, T. 22S, R. 17E).

All of the known localities for *P. (O.) leitheuseri*, including those sight records



of cave divers, occur within a karst area in the Gulf Coastal Lowlands region (as defined by White 1970), in southwestern Hernando and northwestern Pasco counties. The range of the species is thought to extend from the salt water of the Gulf of Mexico on the west to the Brooksville Ridge on the east. The northern and southern limits are currently undefined, but presumably they lie between the Withlacoochee River and Tampa Bay. The Brooksville Ridge appears to form an effective barrier to the eastern expansion of the species. It may also separate *P. (O.) leitheuseri* from the closely related *P. (O.) lucifugus lucifugus* (Hobbs, 1940) which occurs on the other side of the ridge near Floral City, in southeastern Citrus County. This "ridge" actually consists of a series of north-south trending ridges that reach elevations in excess of 60 meters. Their surfaces are covered with sand, which, in turn, is underlain with clastic sediments of the Bone Valley and Alachua formations (White 1970). Thick deposits of white sand, thought to be old stabilized dunes, occur along the western margins of the ridge complex. Franz and Lee (1982) proposed that when moderate to heavy accumulations of unconsolidated sediments cover underlying limestones, they disrupt the flow of organic detritus into the aquifer and produce a severely energy-limited system that excludes troglobitic crayfishes.

*Variations.*—The tubercles, and especially the spines, ornamenting the specimens from Arch and Nexus sinks are much more prominent than in those from the other localities; however, their numbers and disposition do not vary conspicuously. Too, the pigment in the eyes of these specimens is much denser and covers a larger area than that in specimens from other localities. Among the 13 specimens for which measurements are available, there seems to be no correlation between size of the crayfish and the ratio of the length of the areola to its width. None of the males has ratios of areola length to carapace length of less than 35.3, but of the eight females, in only two is the ratio greater: 35.7 and 37.2, while in only two of the five males is the ratio greater than 37.2. As for the ratio of areola length to postorbital carapace length, there seems to be no correlation with carapace length.

*Relationships.*—*Procambarus (Ortmannicus) leitheuseri* has its closest affinities with *P. (O.) lucifugus* and its allies and, perhaps surprisingly, shares more in common with *P. (O.) lucifugus alachua* (Hobbs, 1940) than with the geographically more proximate nominate subspecies. In addition to possessing a black pigment spot in the eye, the rostral margins are usually tapering anteriorly, at most weakly biconvex; the postorbital ridges are provided with tubercles or spines in addition to that capping the anterior extremity, and the areola is comparatively broad, all characters shared with *P. (O.) lucifugus alachua* rather than with the nominate subspecies. It differs from the former chiefly in features of the first pleopod of the first form male: the caudal process is obsolete; the hump, which is present at the cephalic base of the cephalic process in *P. (O.) lucifugus alachua* is less prominent and bent mesially; and the cephalic process is proportionately longer. In addition, the areola is also broader, more so than in most of the Floridian troglobitic members of the subgenus.

*Ecological notes.*—*Procambarus (O.) leitheuseri* has been found in flooded caves at water depths between 16.7 and 69.9 meters. These caves are developed in the upper Eocene limestones of the Ocala Group and are apparently integral

parts of a major conduit system that carries fresh water toward the Gulf of Mexico. Vertical shafts formed in the Suwannee Limestone (Oligocene age) connect caves with the surface. Shafts typically open in the bottom of water-filled sinkhole depressions. Some of these depressions show daily fluctuations in their water levels that may be related to tidal activity on the Gulf. Tides may also account for the observed flow reversals encountered at Eagle's Nest. According to W. K. Fehring, there is a salt water layer at a depth of 27.4 meters in the Beacon Woods system, particularly at Nexus Sink, in Pasco County. Crayfish have been observed only in the freshwater zone above the halocline. Fehring and his associates are studying the waters in the cave systems along the Gulf coast.

Divers report that a rain of silt passes through the vertical shafts from the surface and is deposited in thick layers on cave floors. The silt either accumulates under the shafts or disperses into the cave, depending on the amount of water movement in the system. Crayfishes are usually associated with the silt. None has been seen in the surface ponds or in the shafts. It is believed that the organic fraction of the silt is generated from biotic production in the surface ponds.

All of the known localities for *P. (O.) leitheuseri* lie within 11.6 km of the Gulf of Mexico. Black Hole and Eagle's Nest occur 1.2 and 1.5 km, respectively, from the Gulf, and their surface ponds are near sea level. Both ponds receive drainage from adjacent wetlands. At Black Hole, the water in the pond and in the cave is usually nearly black in color (hence the name) due to continual drainage of acidic water from surrounding red bay (*Persea borbonia*) dominated bayheads. Die Polder 2 and 3 and Beacon Woods sinks occur near the 12.1 meter contour, and are located in sandhills near the base of the Brooksville Ridge in a longleaf pine-turkey oak-wire grass association.

At Eagle's Nest, *P. (O.) leitheuseri* was collected with *Troglocambarus malaneii* Hobbs, and the troglobitic amphipods *Crangonyx grandimanus* Bousfield and *C. hobbsi* Shoemaker.

Key to Troglobitic Members of Subgenus *Ortmannicus*  
(Modified from Hobbs *et al.* and Daniel 1977:26-27)

- |      |  |   |
|------|--|---|
| 1    | Eyes with pigment .....  | 2   |
| —    | Eyes without pigment .....   | 5   |
| 2(1) | Pigment in eyes red .....  | 3   |
| 2'   | Pigment in eyes black .....  | 4   |
| 3(2) | Several cervical spines present; postorbital ridge with spines caudally; male with hook on ischium of fourth pereopod opposed by tubercle on basis; cephalic process of first pleopod of male situated lateral to central projection. Female with caudally directed tuberculiform processes on caudal margin of sternum immediately anterior to annulus ventralis .....          | <i>orcinus</i> Hobbs and Means, 1972      |
| 3'   | Only 1 cervical spine present; postorbital ridge without spines caudally; male with hook on ischium of fourth pereopod not opposed by tubercle on basis; cephalic process of first pleopod of male situated anterior to central projection. Female lacking caudally directed tuberculiform processes on caudal margin of sternum immediately anterior to annulus ventralis ..... | <i>erythropis</i> Relyea and Sutton, 1975 |



- 4(2') Areola more than 10 times as long as wide; first pleopod of male, form I, with caudal process and with hump at cephalic base of cephalic process. (The eyes of about 50% of the intergrade population in Marion County, Florida, lack pigment.) . . . . . *lucifugusalachua* (Hobbs, 1940)
- 4' Areola less than 10 times as long as wide; first pleopod of male, form I, with caudal process obsolete and lacking hump at cephalic base of cephalic process . . . . . *leitheuseri*, new species
- 5(1') Male with hook on ischium of fourth pereopod distinctly overreaching basioischial articulation; female with multituberculate sternum immediately anterior to annulus ventralis . . . . . 6
- 5' Male with hook on ischium of fourth pereopod not overreaching basioischial articulation; female without tubercles on sternum immediately anterior to annulus . . . . . 7
- 6(5) Postorbital ridge with spines or tubercles caudally; areola less than 20 times as long as broad. Male with cephalic process of first pleopod situated lateral to central projection . . . . *horsti* Hobbs and Means, 1972
- 6' Postorbital ridge without caudally situated spines or tubercles; areola more than 20 times as long as broad. Male with cephalic process of first pleopod situated cephalic to central projection . . . . . *pallidus* (Hobbs, 1940)
- 7(5') Rostrum narrower at base than over eye; areola more than 20 times as long as wide; first pleopod of male with preapical curvature of at least 80 degrees (see note concerning eye pigment in couplet 4) . . . . . *lucifugus lucifugus* (Hobbs, 1940)
- 7' Rostrum tapering from base; areola less than 20 times as long as wide; first pleopod of male with preapical curvature of no more than 60 degrees . . . . . *franzi* Hobbs and Lee, 1976

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